Prey as Drivers of Golden Eagle Populations in the western U.S.

Presentation to the California / Nevada Golden Eagle Working Group

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Objectives

- Provide basic review of Golden Eagle diets
- Obtain and quantify new or unpublished data
- Quantify spatial and temporal patterns
- Provide foundation for management of prey resources

Photo: Brian Woodbridge

Golden Eagle Food Habits

1

1

- Diverse Diet
  - Virginia's Warbler (Keller 2014) →
    Brown Bear cub (Sørensen 2004)
  - Opportunistic Hunters, Local Specialists

2

Leporids – Rabbits and Hares

2

2

Sciurids – Ground Squirrels

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[2]Brian Woodbridge

Food Resources as Drivers of Population Dynamics

- **Prey quality influences fecundity**
  - Leporid population numbers were related to decreased reproductive parameters and overall GOEA population sizes (Oakleaf et al. 2014; Steenhof et al. 1997; Thompson et al. 1982); Preston (this conference)

- **Other influences of prey:**
  - **Source of contaminants**
    - Lead poisoning (Haig et al. 2014; Stauber et al. 2010)
    - Anticoagulant rodenticide (White et al. 2014)
  - **Conflict with Golden Eagles as predators of**
    - Livestock (Matchett & O'Gara 1987)
    - Sage Grouse(USFWS 2004; Hartzler 1974; Arnold 1954)

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State of Knowledge

- Diet Reviews
  - BNA Species Profile (Kochert et al. 2002)
  - Olendorff (1976)
- Non-breeding season (Fall and Winter)
  - Dietary information lacking
  - 5 quantified studies
    - Stomach content analysis (Arnold 1954; Woodgerd 1952)
    - Direct observation (Marzulff 1997; Marr & Knight 1983; Edwards 1969)
    - Field reports: (McWilliams et al. 1994; Deblinger & Alldredge 1996; Goodwin 1977; others)

Breeding Season Diet

- 31 quantified food habits studies from 1954–2015
  - Majority identified prey items in / around nests
  - Direct observation / camera (Longshore et al. 2015; Collopy 1983; Lockhart 1976)
  - 43,693 total prey items identified

Photo: Brian Woodbridge

Addressing Bias in the Identification of Prey Remains

Photo: Kent Keller

- Only represents prey items collected for young
- Bias: larger, heavier bones
- Large prey items → body parts
- Direct observation is more reliable for biomass calculations

Methods

- Compile a comprehensive synthesis of information on Golden Eagle diet in the western U.S.
  - Published breeding season data
  - Unpublished data sets (Woodbridge; Steenhof & Kochert; Keller)
  - Diet Studies in prep. for publication (Longshore et al.; Watson and Davies; Preston; Heath and Kochert*)
- Spatial Analysis: ArcMap geodatabase
- Temporal Analysis: Central Utah, Southwest Idaho
- Separate analysis of Kent Keller's data for Central Utah (Bedrosian, Keller, and Brown*)

Photo: Kent Keller

*In preparation for publication

Partitioning the Range

- Breeding range of Golden Eagles in the Western United States, excluding Alaska
- Council for Environmental Cooperation (CEC) Ecoregions (NABCI 2000)
- Levels I, II, and III

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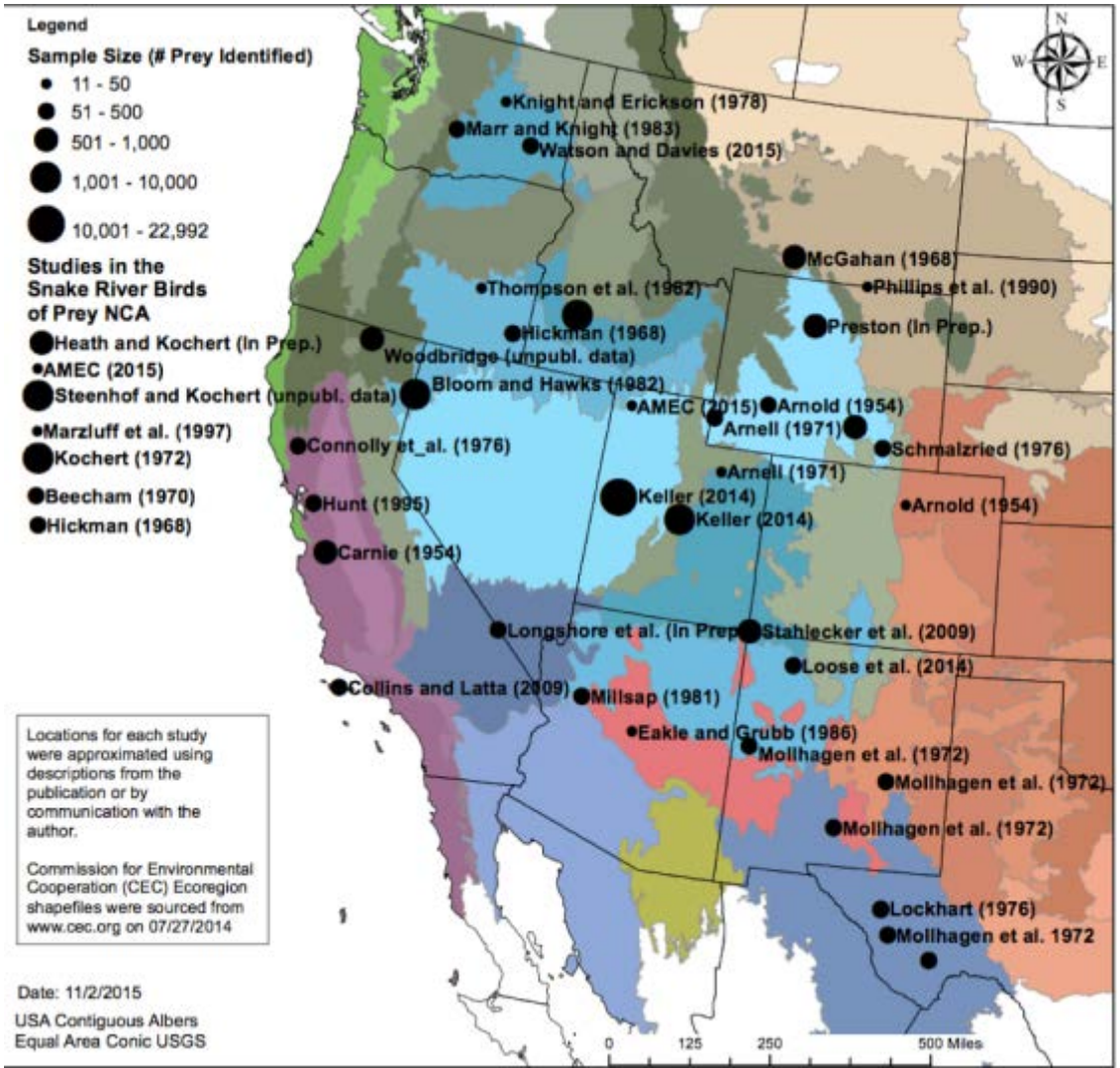
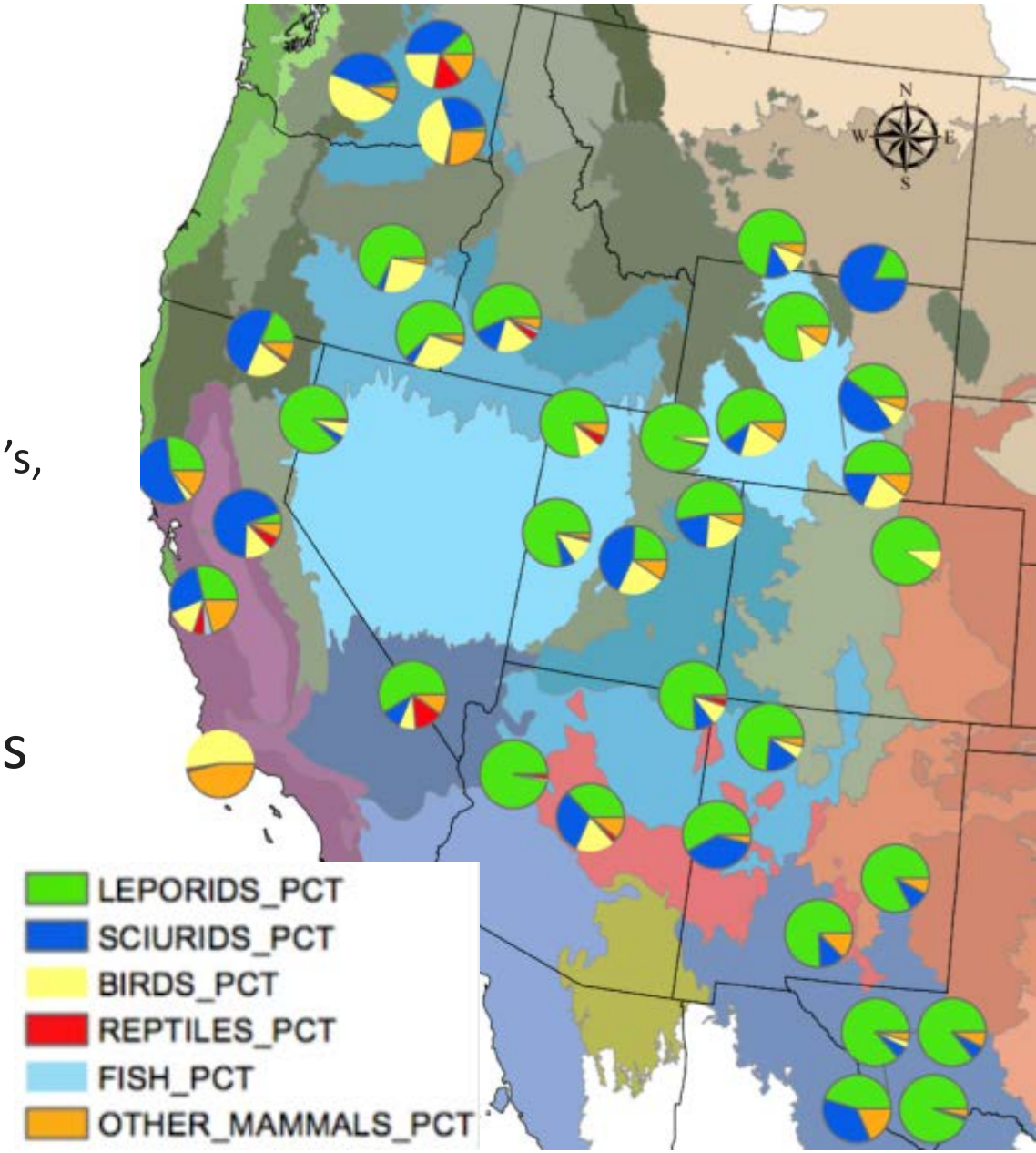
Breeding Season Diet Studies

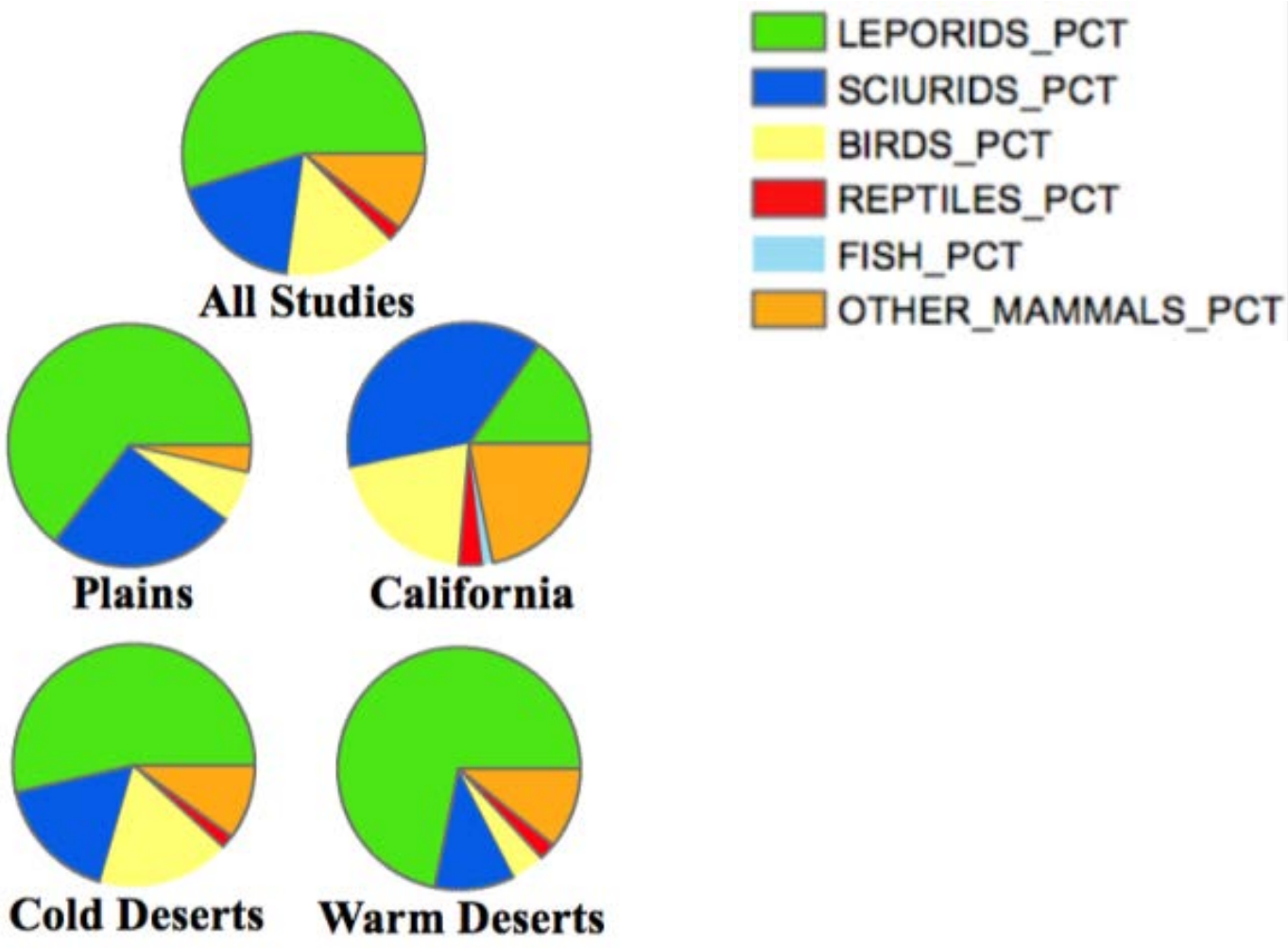


Top Prey Groups

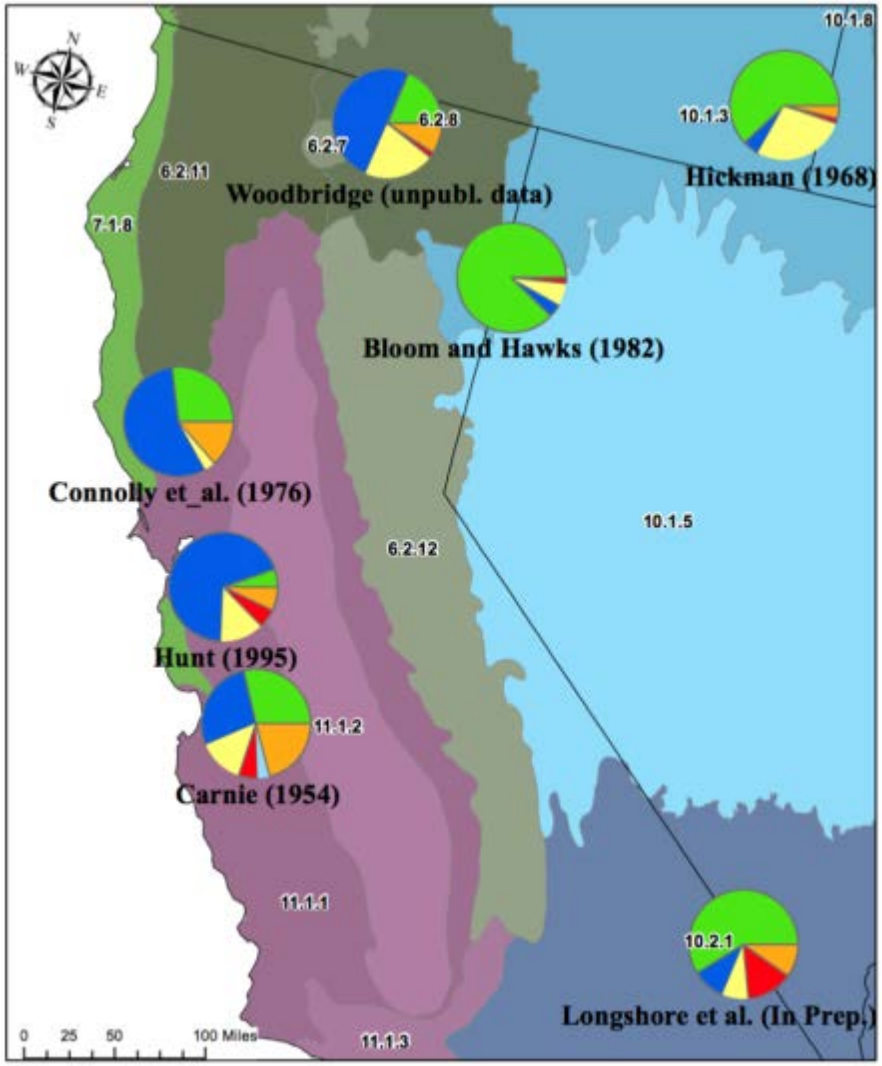
- Leporids
  - Jackrabbits, cottontails
- Sciurids
  - Ground squirrels (Belding's, Rock, California)
  - Yellow-bellied marmot
  - Prairie dogs
- Birds – diverse species
  - Black-billed magpie
  - Ring-necked pheasant
  - Ducks

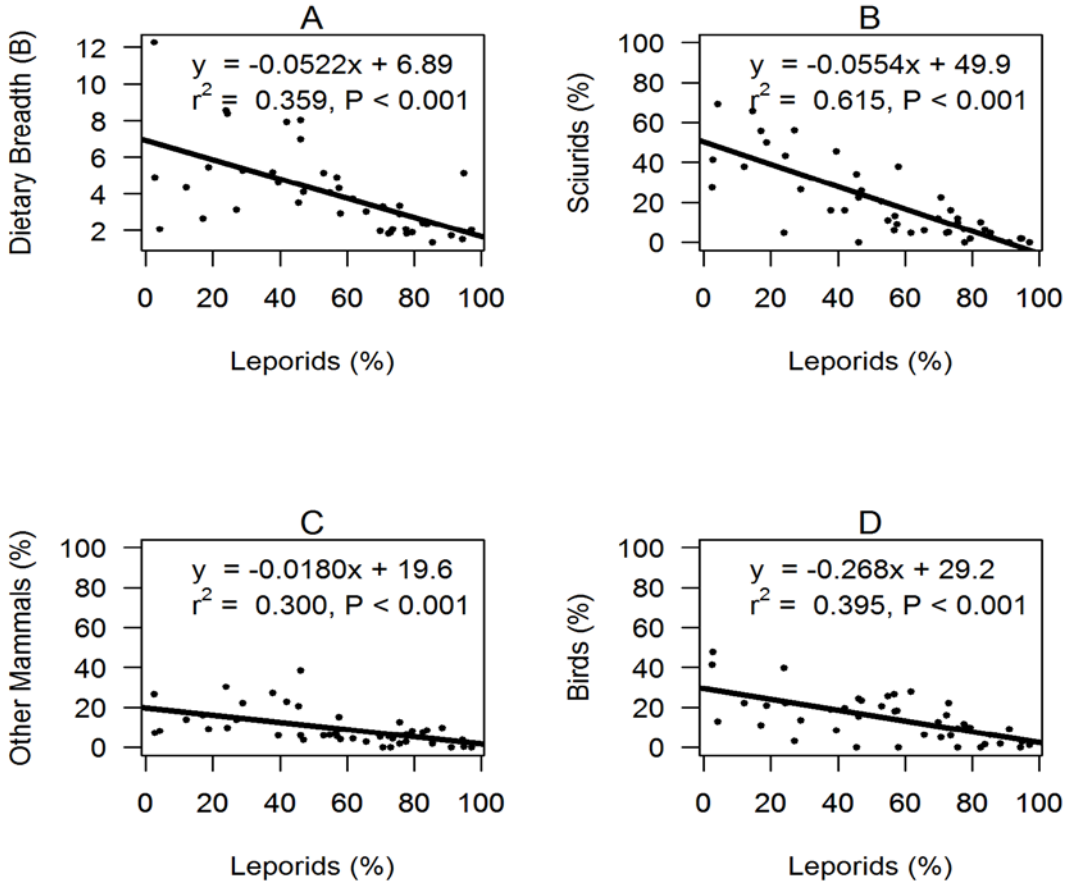


Regional Trends in Golden Eagle Diet



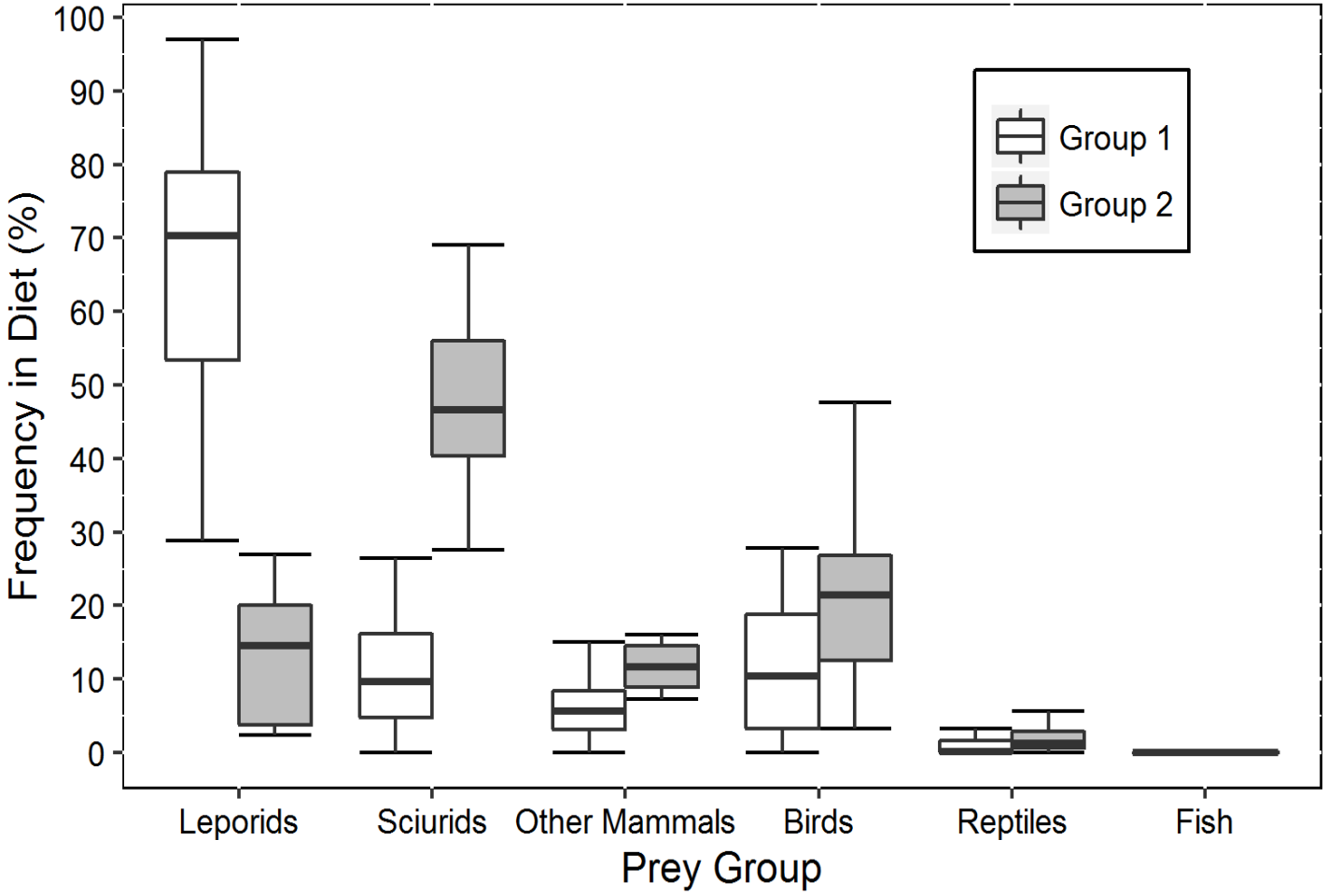
Golden Eagle Diet in California





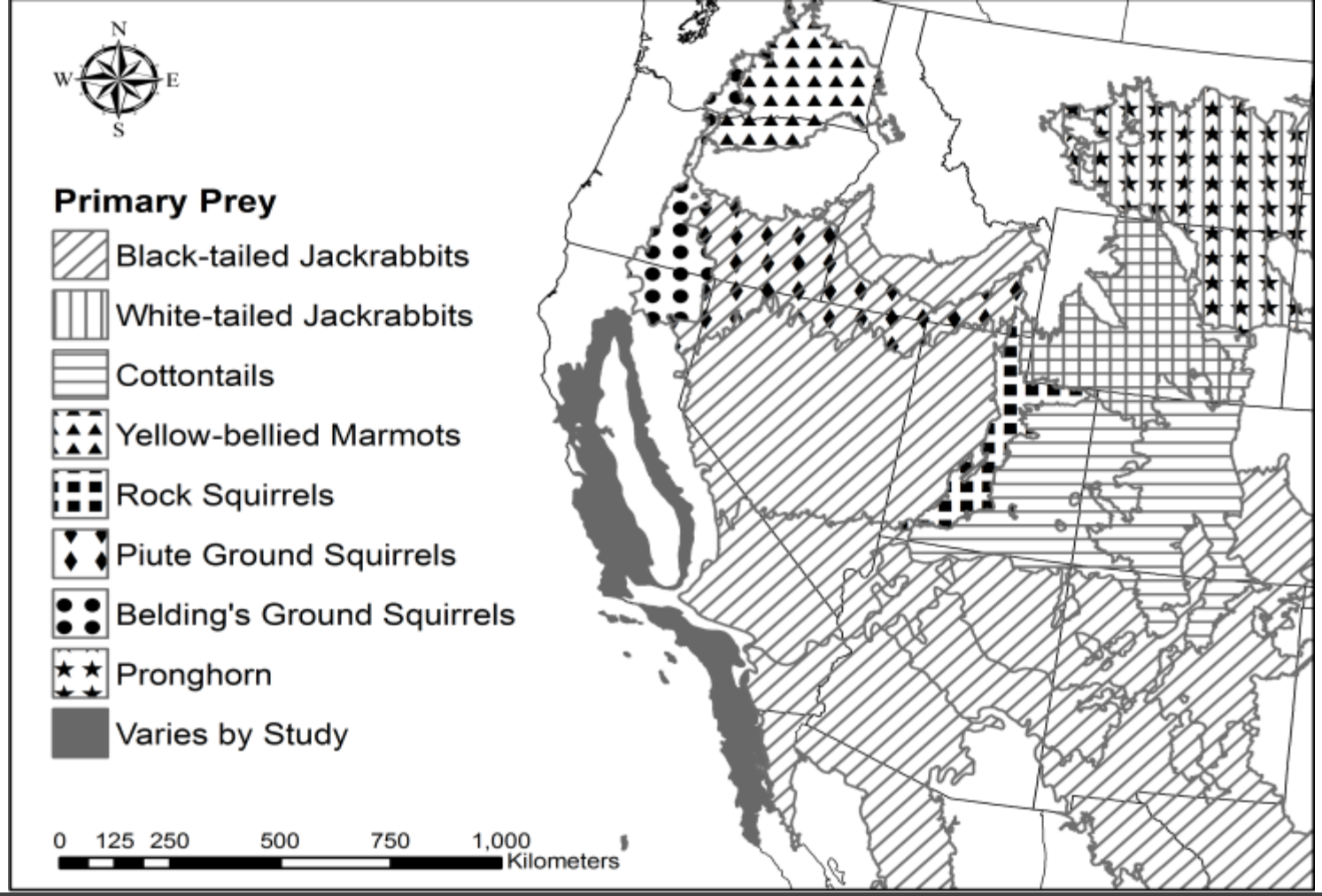
Presence of Leporids as drivers of dietary characteristics

Linear models with significant relationships ($P \leq 0.001$) between the frequency of leporids in the diet of Golden Eagles dietary breadth (A), sciurids (B), other mammals (C) and birds (D).



Primary Prey of Group 1 = Leporids, Group 2 = Sciurids

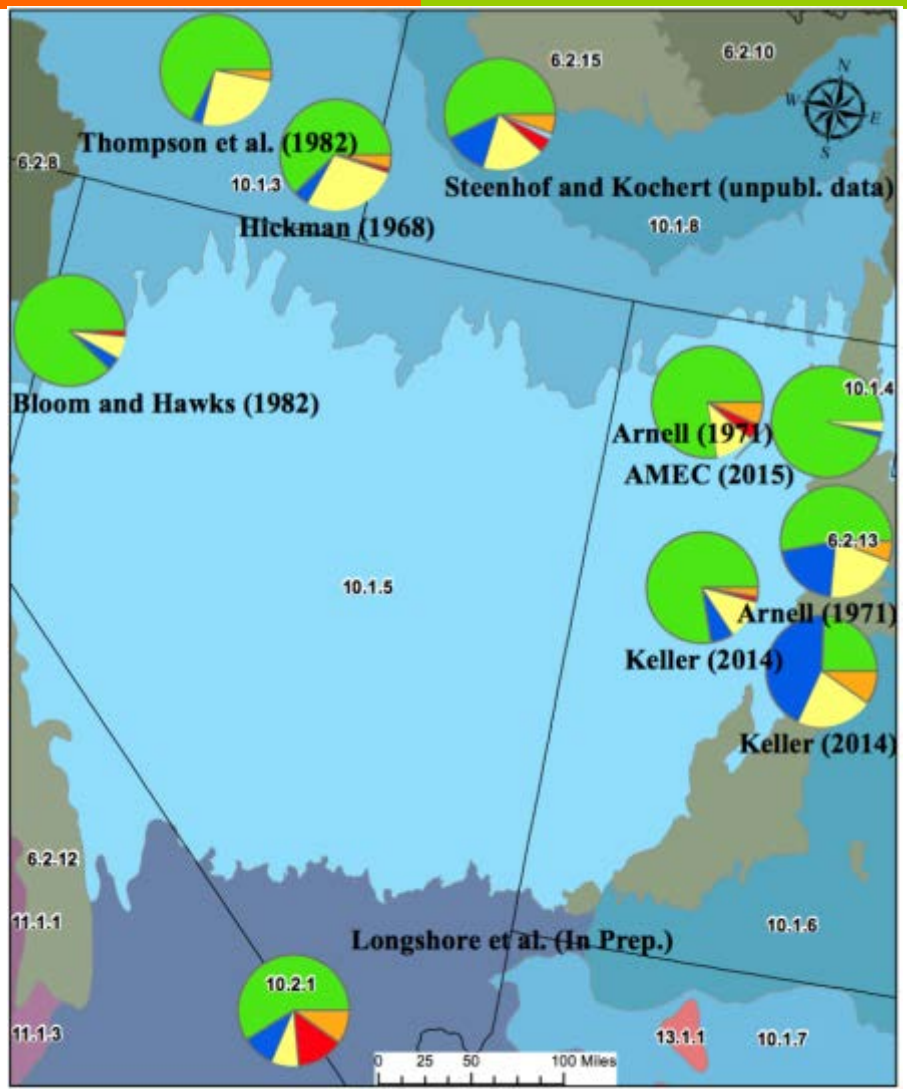
Comparison of Golden Eagle breeding season diets between two significantly different ($P \leq 0.05$) groups of diet studies identified by cluster analysis. Bold lines in the center of boxes represent the mean, edges are the first and third quartiles, and whiskers contain the 95% confidence interval.



Primary Prey Species by CEC Ecoregion

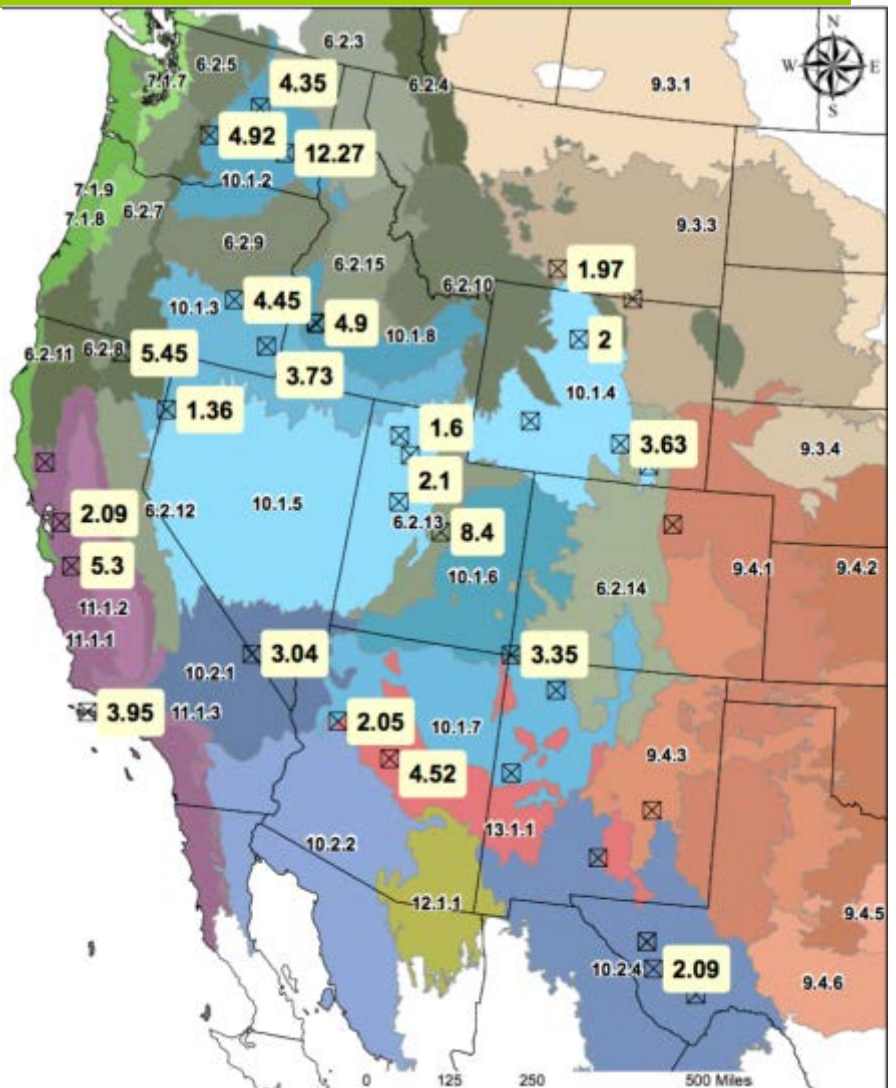
Primary prey of Golden Eagles during the breeding season in CEC Level 3 Ecoregions. Overlapping labels indicate that different primary prey species were reported among diet studies in a given ecoregion.

Golden Eagle Diet in the Great Basin



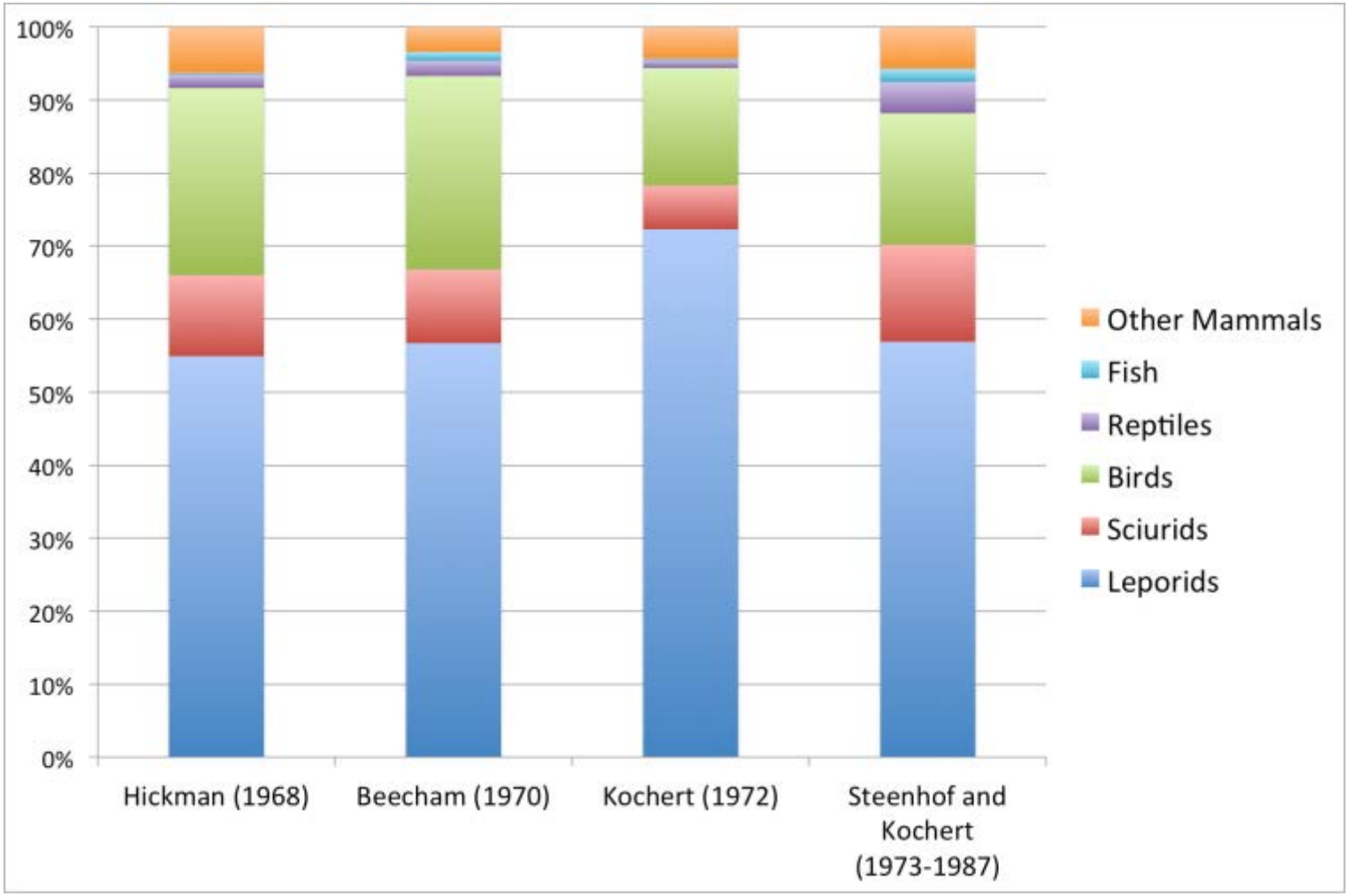
Dietary Breadth

- Average All Studies = 3.94
  - Range 1.36 – 12.27
- Cold Deserts / Shrubsteppe
  - Average = 4.19
- Warm Deserts / Southwest
  - Average = 2.93
- Wasatch and Uinta Mountains
  - Keller 2014 = 8.40

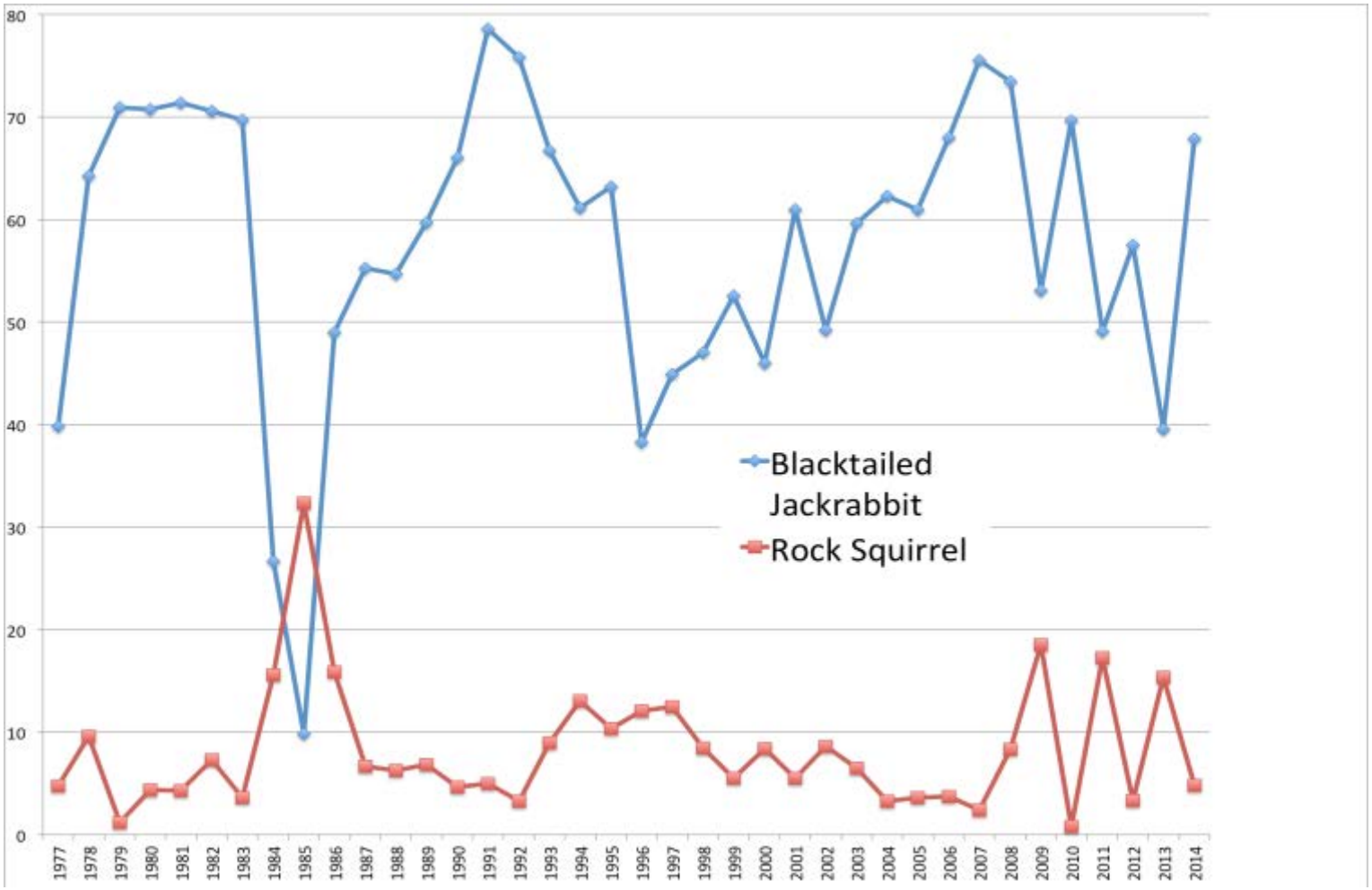


Dietary Breadth Calculated Using Levin's formula: $B = 1/\sum p_i^2$

Dietary Shift – Southwest Idaho



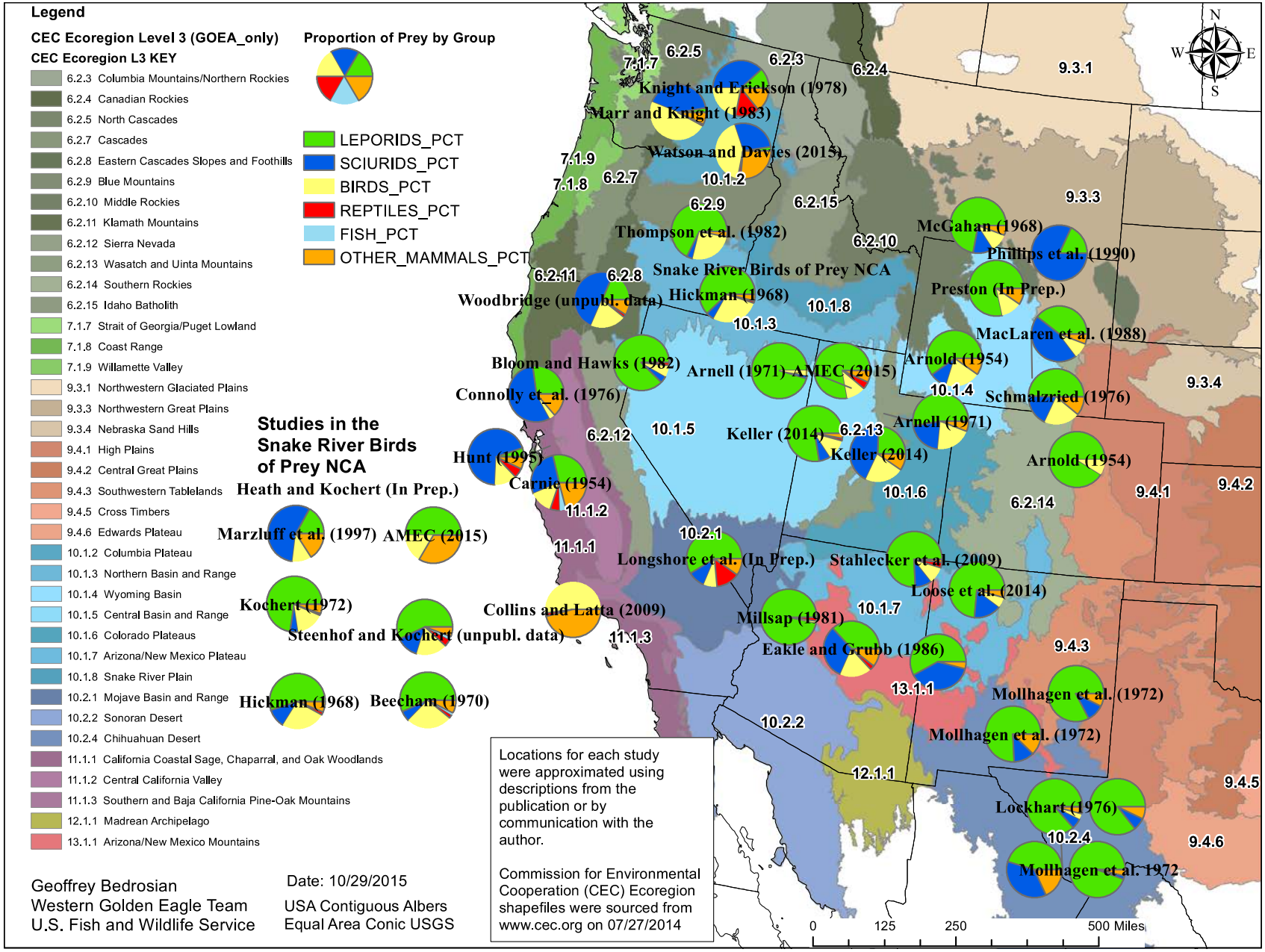
Dietary Shift– Central Utah



Products Under Development*

- Golden Eagle Diet Synthesis Report
- Geodatabase of prey data accessed through a web-based map application
- Prey species accounts for principal prey species
- Prey species habitat management reviews
- Analysis of Keller's data for Central Utah (presentation tomorrow)

*Stop by the Western Golden Eagle Team Poster for more information!



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Western Golden Eagle Team
U.S. Fish and Wildlife Service

Date: 10/29/2015

USA Contiguous Albers Equal Area Conic USGS

Future Research Needs

- Nonbreeding season diets
  - Importance of carrion for overwinter survival
- Jackrabbits & Fecundity
  - Response to crashes
  - Historical data analysis
- Response to Environmental Change
  - Cheatgrass / invasive spp.
  - Climate change

Photo: Todd Katzner

Conclusions

- Applications to Conservation
  - Golden eagles are opportunistic generalist predators
  - Diverse prey base important to allow for shifting
  - Prey habitat management → Land management practices
  - Ecoregion model → Landscape specific conservation strategies

Photo: Roger Lee

Acknowledgements

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Questions and Discussion